R.B. EKBLAD

1989

Management Question

?

How Well Does Model Represent Real World?

Two Points

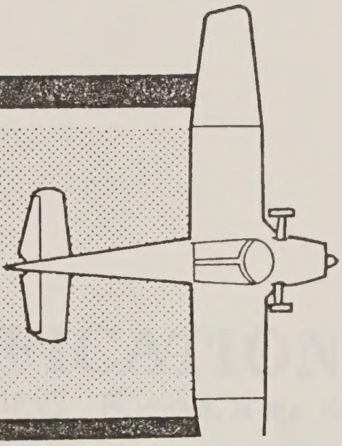
1. AGDISP is widely available, user friendly and economical to run on a PC XT or Data General minicomputer

2. AGDISP adequately represents the real world for representation of most "near aircraft" aerial application predictions.

Shea, Barry, Armstrong
Millers, Bergen, Ekblad

A PROBLEM ANALYSIS

Forest and Range Aerial Pesticide Application Technology



JULY 1979

Problem Area	Priority1/	Expected Contribution to Drift Reduction	 Cost Reduction	 Increased Efficacy
Aircraft Delivery Systems	9	High	High	High
Aircraft Guidance	7	High	Low	High
Application Strategy	6	Medium	Low	High
Biological Interface	4	Low	Low	High
Meteorology	6	High	Low	Medium
Pesticide Safety	3	Low	Low	Low
Spray Behavior	8	High	Medium	High
Spray Drift	5	High	Low	Low
Sampling	3	Low	Low	Low
Technology Transfer ? NOW	9	High	High	High

1/ Priority on scale from 1 to 10; 10 highest, 1 lowest.

U.S. Department of Agriculture ■ Forest Service

MODEL CLASSIFICATIONS

Borrowed from FIRE RESEARCH

- Mental Models
- Statistical Models
- Gaming Models
- Empirical Models
- Simulation Models
- Mathematical Programming Models
- Mechanistic Models

USES of
AGDISP and FSCBG Models

Selecting: & Comparing	
Aircraft and Spray Systems	AGDISP
Nozzle Position on Spray Booms	AGDISP
Flight Altitudes	AGDISP,FSCBG
Swath Widths	AGDISP,FSCBG
Tank Mixes	AGDISP,FSCBG
Application Rates	AGDISP,FSCBG
Drop-Size Spectrum	AGDISP,FSCBG
Atmospheric Conditions	FSCBG
Application Timing	AGDISP,FSCBG
Effect of Evaporation	
Developing Spray Prescription for Specific Treatment Sites	AGDISP,FSCBG
Preparing Environmental Analyses	AGDISP,FSCBG
Post-Spray Evaluations	AGDISP,FSCBG

Sensitivity
Valide

Weather Theory

> "Every theory of the course of events in nature is necessarily based on some process of simplification of the phenomena and is to some extent therefore a fairy tale."
>
> Sir Napier Shaw, Manual of Meterology

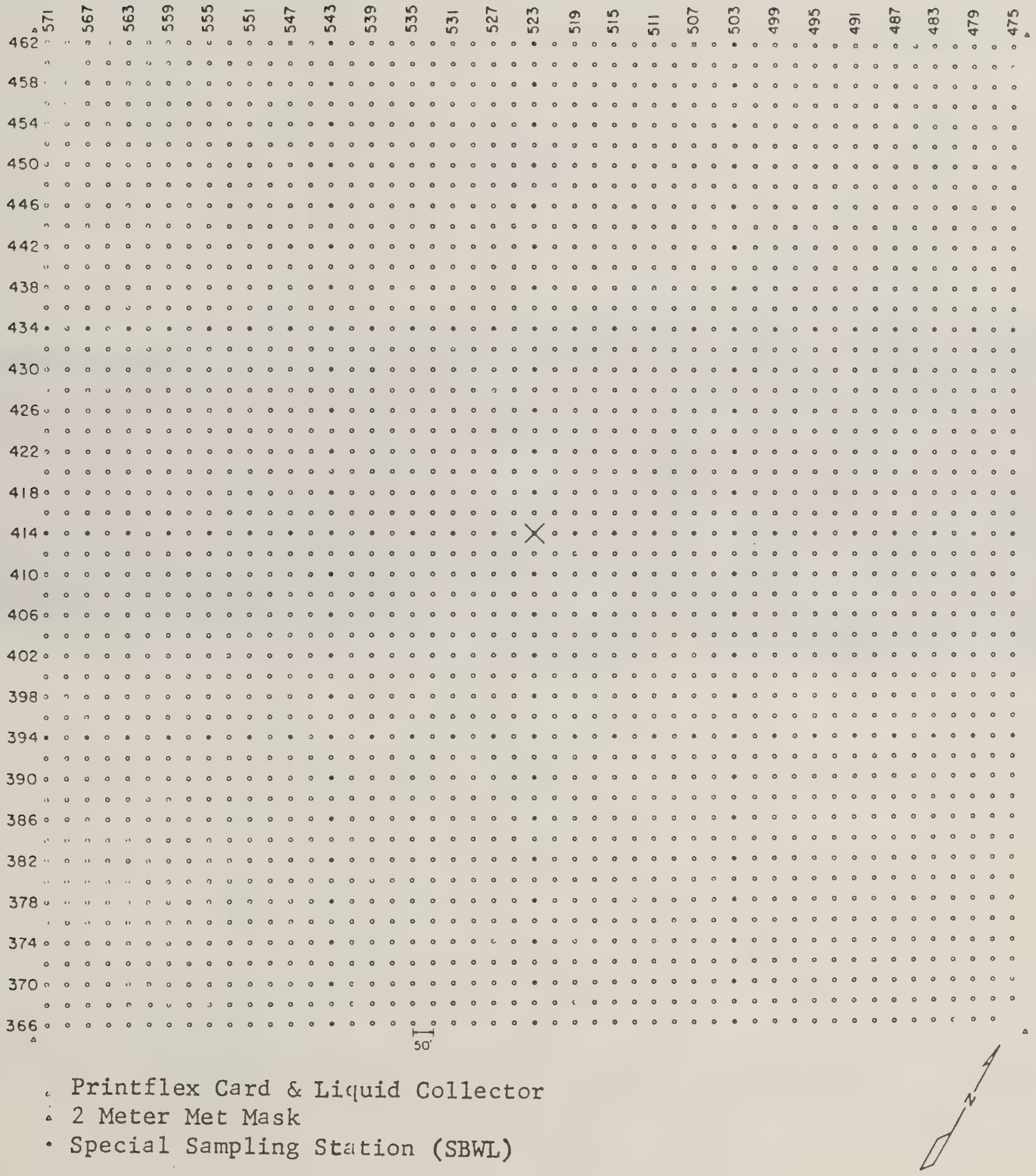


Figure 2-1. Grid Array for DPG Trials

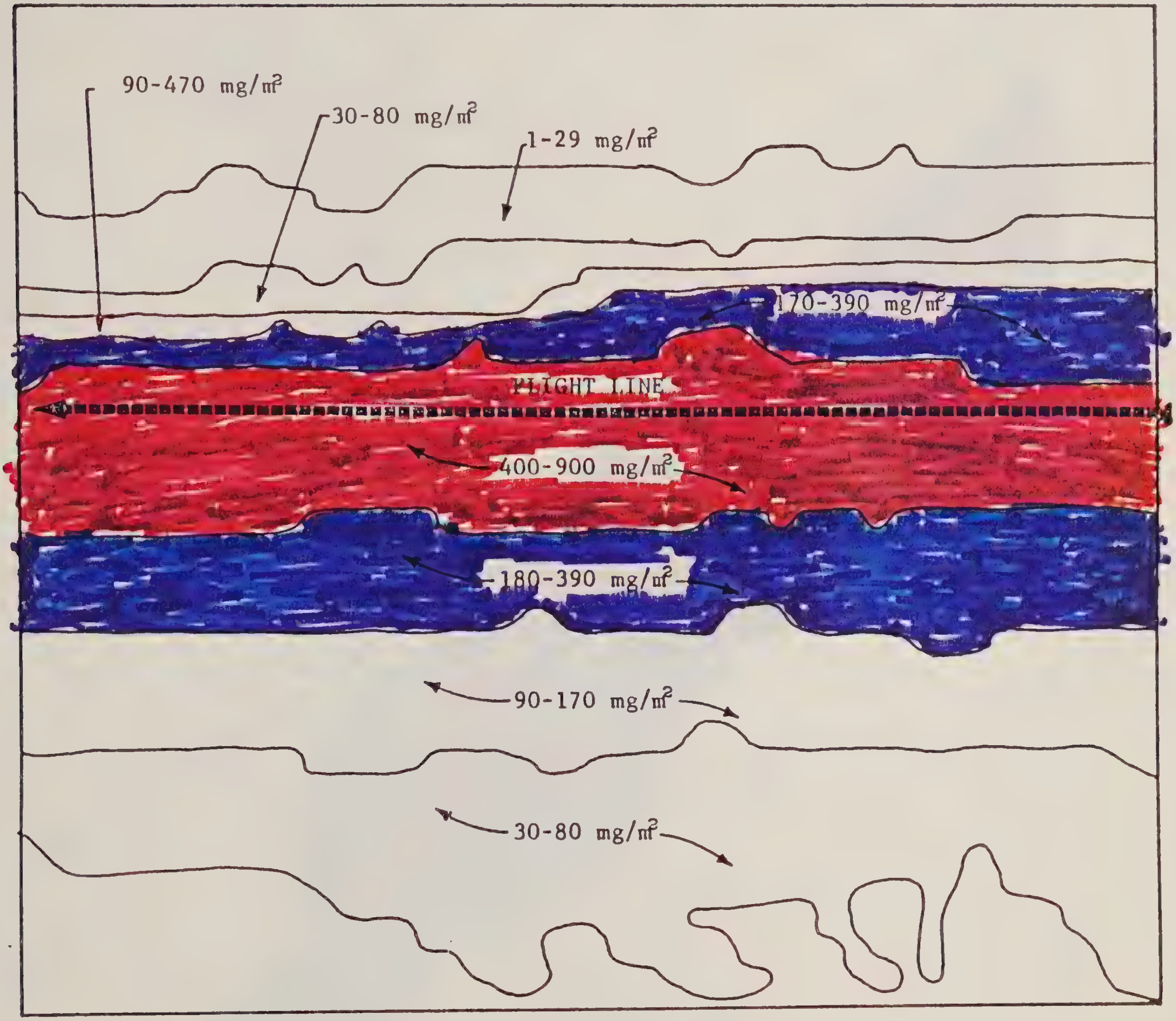
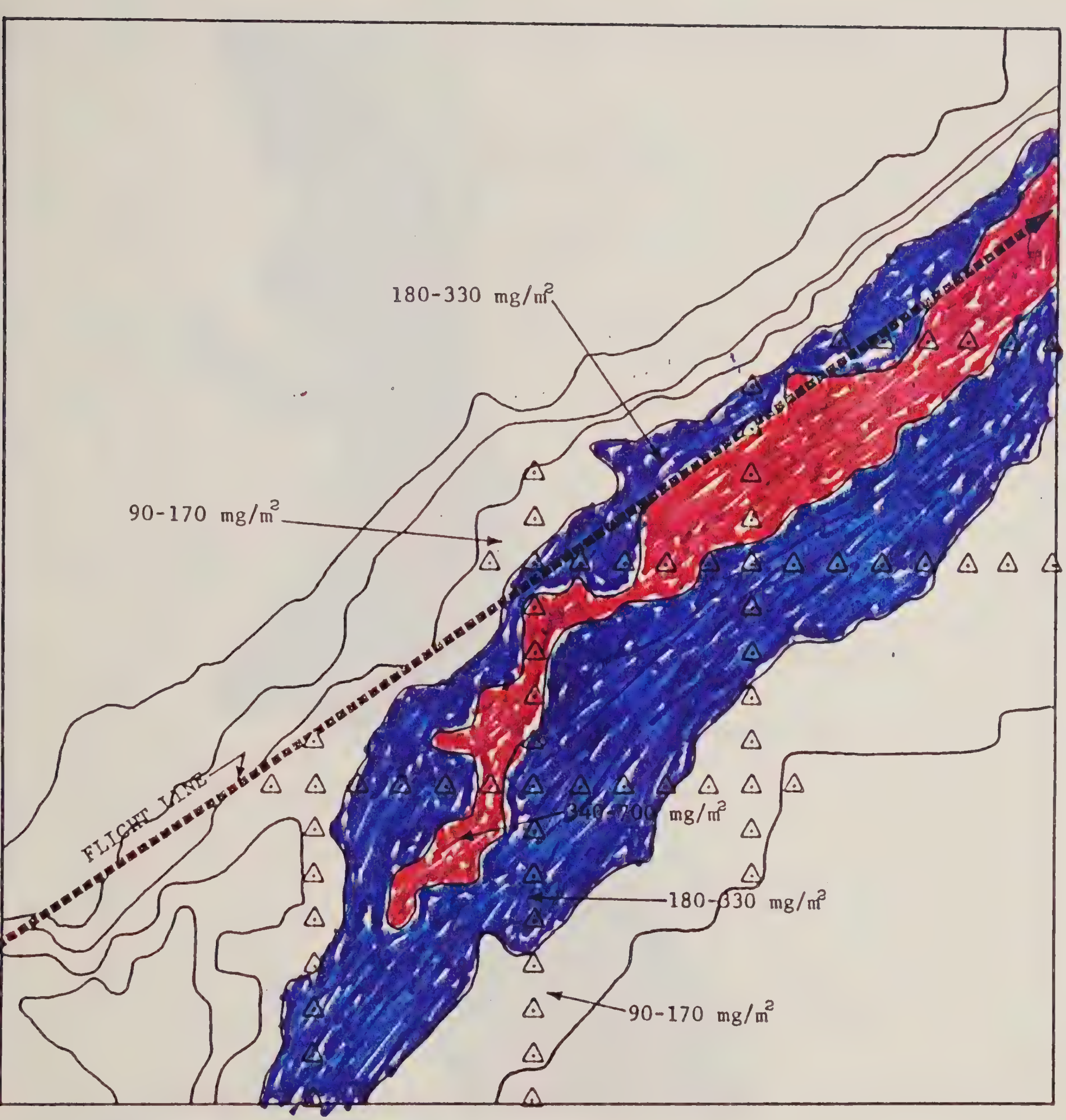


Figure 2-2. Contour Diagram Showing Area Covered by Selected Deposition Density Levels for the Zectran Mixture on Trial FS-1 (C-47/USFS Spray System)



△ = 100 percent Spruce Budworm Larvae Mortalities

Figure 2-3. Contour Diagram Showing Area Covered by Selected Deposition Density Levels for the Zectran Mixture for Trial FS-2 (C-47/USFS Spray System)

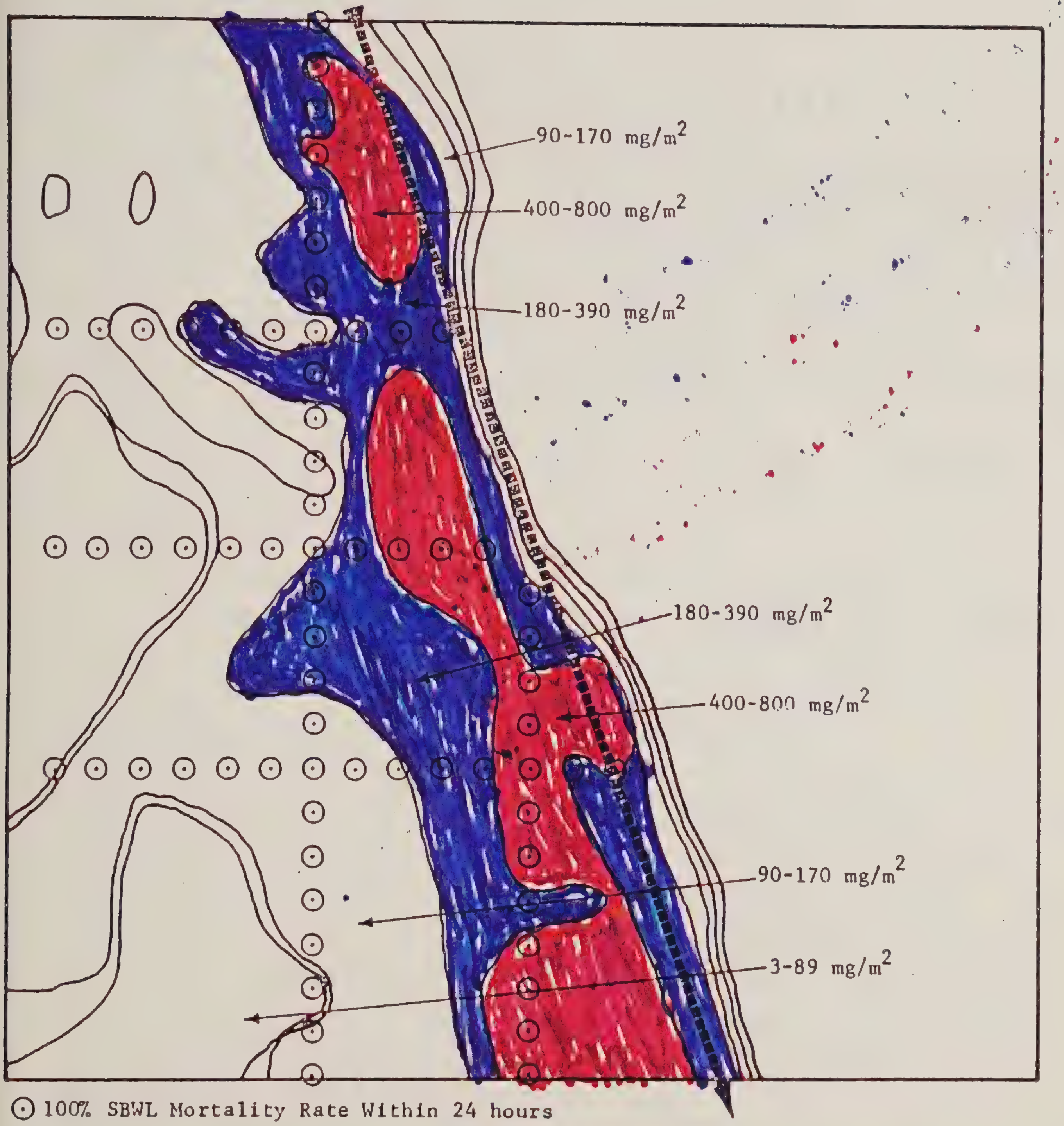


Figure 2-5. Contour Diagram Showing Area Covered by Selected Deposition Density Levels for the Zectran Mixture on Trial FS-4 (C-47/MISS)

MENU OPTIONS 1987

0 EXIT AGPLOT
1 MEAN PARTICLE TRAJECTORIES
2 MEAN + STANDARD DEVIATION TRAJECTORIES
3 VORTICES/HELICOPTER/ENGINE CENTROIDS
4 GROUND DEPOSITION -- CURRENT FILE
5 GROUND DEPOSITION -- MULTIPLE FILES
6 EQUIVALENT GAUSSIAN DISTRIBUTION
● 7 CROSSWIND VELOCITY PROFILE
8 PLANT AREA DENSITY PROFILE
9 DROPLET DIAMETER TIME HISTORY
● 10 DROPLET VERTICAL VELOCITY TIME HISTORY

OPTIONS AVAILABLE 1989

0 EXIT AGPLOT
1 MEAN DROPLET TRAJECTORIES
2 MEAN + STANDARD DEVIATION TRAJECTORIES
3 VORTICES/HELICOPTER/ENGINE CENTROIDS
4 GAUSSIAN GROUND DEPOSITION
5 CONTINUOUS GROUND DEPOSITION
6 CANOPY DEPOSITION
7 TOTAL CANOPY DEPOSITION
8 EQUIVALENT GAUSSIAN DISTRIBUTION
9 CROSSWIND VELOCITY PROFILE
10 CANOPY PLANT AREA FRACTION PROFILE
11 DROPLET DIAMETER TIME HISTORY
12 DROPLET CANOPY PARAMETER TIME HISTORY
13 DROPLET AXIAL VELOCITY TIME HISTORY
14 DROPLET HORIZONTAL VELOCITY TIME HISTORY
15 DROPLET VERTICAL VELOCITY TIME HISTORY
16 OBJECT DEPOSITION TIME HISTORY
17 DRIFT FRACTION TIME HISTORY

- Not all options will be "active" in any run -- AGDISP inputs control the content of the BIN plot files.

MODIFICATION LEVEL

AGDISP code development has lead to the following versions of the code.

Mod. 2.0 Operational on a Control Data CYBER 175 at NASA-Langley.

Includes: all of the basic program development: fully rolled-up vortices or Betz roll-up, simplified terrain modeling, WAKE plot file entry, models for propeller, helicopter, crosswind, superequilibrium turbulence, canopy, vortex penetration into canopy, and material evaporation. Also includes a stand-alone program (AGLINE) to construct the equivalent Gaussian distribution.

Graphics: Tektronix 4025 and 401X terminals using NASA-Langley graphics software calls.

Source Code Available from NASA

Mod. 3.0 Operational on a Univac 1108 at Ft. Collins (U.S. Forest Service).

Improvements: helicopter modeling with transition to rolled-up vortices; AGLINE calculations as a menu option in AGPLOT.

Additions: discrete crosswind velocity profile; nonzero deposition height; composite deposition plots (to 16 plot files); canopy penetration by helicopter downwash; plot option to plot material diameter time history.

Graphics: DISSPLA at Ft. Collins, with appropriate subroutine calls for Tektronix terminals.

Mod. 4.0 Operational on a VAX 11/785 at Dugway Proving Grounds (U.S. Army).

Improvements: Betz roll-up procedure and propeller model revised; equivalent Gaussian distribution selection criterion is a program decision involving material vertical velocity.

Additions: models for wide body effects, simple vortex circulation decay, jet engines, multiple powerplants and parameterized evaporation; default input file option; plot option to plot material vertical velocity time history.

Graphics: CALCOMP at Dugway, with appropriate subroutine calls for the pen plotter.

Mod 5.0 Operational on a Data General MV-15000 at Missoula, and on IBM PC/XT/AT personal computers.

Improvements: Revised solution procedure eliminates integration stepsize dependence on material decay time constant.

Additions: Axial variation added to all models; ground sprayer; continuous deposition; canopy deposition; deposition on objects.

Graphics: GKS at Missoula; dot matrix printer output on IBM PC/XT/AT.

Add English Units
Add numeric Output

Two Points

1. AGDISP is widely available, user friendly and economical to run on a PC XT or Data General minicomputer

2. AGDISP adequately represents the real world for representation of most "near aircraft" aerial application predictions.

Proposed Funding for AGDISP Enhancements

TASK

1. Deposition of non-volatiles
2. Add other atmospheric stability conditions
3. Enhance dry material option
4. Data verification of canopy and sampler deposition
5. Inputs for complex terraain interface
6. Toolkit for advanced users
7. Update new version at Missoula on Data General
8. Update AGDISP manual
9. Two training sessions

10 Add user friendly front end
11 Add automatic multiple drop runs
12 Incorporate suggestions from trainees
13 Add driver for HP plotter
14 Conduct sensitivity studies
15 Analyze Mission helicopter data

TOTALS